The Influence of Regional Anthropogenic Emission Reductions on Aerosol Direct Radiative Forcing

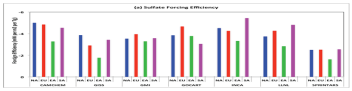
Research Highlight

Anthropogenic aerosols contribute to the global mean radiative forcing. Uncertainties associated with these aerosol radiative forcings are the largest contributor to the overall uncertainty in anthropogenic radiative forcing of climate. Assessments of how regional emission changes will influence aerosol radiative forcing are required from both a scientific and policy perspective.

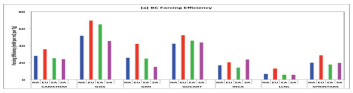
This study assesses changes of aerosol optical depth (AOD) and direct radiative forcing (DRF) in response to the reduction of anthropogenic emissions in four major pollution regions in the northern hemisphere by using results from nine global models (including the IMPACT model funded by DOE) in the framework of the Hemispheric Transport of Air Pollution (HTAP). DRF at top-of-atmosphere (TOA) and surface is estimated based on AOD results from the HTAP models and AOD-normalized direct radiative forcing from a chemical transport model.

The majority of models give a lower sulfate forcing efficiency for SO2 emissions from east Asia than that from Europe, and the largest black carbon forcing efficiency for the European emissions.

The large spread among models highlights the need to improve aerosol processes in models and evalulate and constrain models with observations.



Global annual mean forcing efficiency (unit: mWm-2 per Tg) attributed to 20% anthropogenic emissions reductions of sulfate in source regions (NA=North America, EU=Europe, EA=East Asia, and SA=South Asia) as simulated by seven HTAP models.



Global annual mean forcing efficiency (unit: mWm-2 per Tg) attributed to 20% anthropogenic emissions reductions of BC in source regions (NA=North America, EU=Europe, EA=East Asia, and SA=South Asia) as simulated by seven HTAP models.

Reference(s)

Yu H, M Chin, J West, C Atherton, N Bellouin, D Bergmann, I Bey, H Bian, T Diehl, G Forberth, P Hess, M Schulz, D Shindell, T Takemura, and Q Tan. 2012. "An HTAP multi-model assessment of the influence of regional anthropogenic emission reductions on aerosol direct radiative forcing and the role of intercontinental transport." Journal of Geophysical Research – Atmospheres, , . ACCEPTED.

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Working Group(s)

Aerosol Life Cycle